JP2002-288655A English Translation

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CLAIMS

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[Claim(s)]

[Claim 1]An image processing device comprising:

An image input means.

An image processing means which makes it correspond to several different spatial filter characteristics to the same image data inputted from a described image input means, and performs two or more spatial filter operations serially.

[Claim 2]A sensor area including a pixel array which has a photoelectric transfer characteristic, and a reading means for reading image data from the above-mentioned pixel array, An image processing device forming in the same semiconductor chip an image processing means which makes it correspond to several different spatial filter characteristics to the same image data read from the above-mentioned sensor area, and performs two or more spatial filter operations serially.

[Claim 3]Have an imaging signal processing circuit characterized by comprising the following, and the above-mentioned control circuit, The image processing device according to claim 1 or 2 taking out serially two or more spatial filter outputs which give the spatial filter characteristic that two or more limited individuals set up beforehand differ, to inputted image data, and are related with the above-mentioned inputted image data.

A spatial filter circuit which the described image processing means can change [ of selectivity about the predetermined geometric feature ].

A control circuit which controls the characteristic of the above-mentioned spatial filter circuit.

[Claim 4]While it has the following and the above-mentioned control circuit outputs a reading control pulse signal of the above-mentioned pixel signal to the above-mentioned sensor circuit, Based on the above-mentioned reading control pulse signal, output a spatial filter characteristic control signal to the above-mentioned spatial filter circuit, and the above-mentioned spatial filter circuit, An image processing device given in any 1 paragraph of claims 1-3 characterized by performing a different predetermined spatial filter process serially to the above-mentioned pixel signal corresponding to a pixel signal output outputted from the above-mentioned transfer circuit.

A sensor circuit which has a transfer circuit which transmits a pixel signal which should read a described image processing means from a pixel array.

A control circuit.

A spatial filter circuit for performing a spatial filter process serially in the different predetermined characteristic.

[Claim 5]While it has the following and the above-mentioned control circuit outputs a reading control pulse signal of the above-mentioned pixel signal to the above-mentioned sensor circuit, Based on the above-mentioned reading control pulse signal, output a spatial filter characteristic control signal to the above-mentioned spatial filter circuit, and the above-mentioned demultiplexer circuits, Based on the above-mentioned reading control pulse signal, carry out a separation output at a different signal wire combined with the above-mentioned spatial filter circuit element, and a time series signal from the above-mentioned sensor circuit the above-mentioned spatial filter constituent circuits. An image processing device given in any 1 paragraph of claims 1-4 characterized by performing a different predetermined spatial filter process serially to the above-mentioned pixel signal corresponding to a pixel signal output outputted from the above-mentioned transfer circuit.

A sensor circuit which has a transfer circuit which transmits a pixel signal which should read a described image processing means from a pixel array.

A control circuit.

Demultiplexer circuits.

A spatial filter array circuit which arranges spatial filter constituent circuits for performing a spatial filter process serially in the different predetermined characteristic.

[Claim 6]An image processing device given in any 1 paragraph of claims 1-5 which is provided with the following and characterized by the above-mentioned control circuit outputting a read pulse signal in sync with an output timing signal of the above-mentioned spatial filter circuit to the above-mentioned transfer circuit.

A transfer circuit to which a described image processing means transmits a pixel signal of a sensor pixel.

A control circuit.

A spatial filter circuit which performs a spatial filter process serially in the different predetermined characteristic.

[Claim 7]The image processing device according to claim 6, wherein the above-mentioned spatial filter circuit performs serially predetermined local spatial filtering in two or more scales in scale space.

[Claim 8]The above-mentioned local spatial filtering is a predetermined multiplex scale spatial filter process which gives an output approximated to a Gabor filter or the above-mentioned Gabor filter output, The image processing device according to claim 7 performing serially filtering which has different scale selectivity and different directional selectivity.

[Claim 9]While it has the following and the above-mentioned control circuit outputs a reading control pulse signal of the above-mentioned pixel signal to the above-mentioned sensor circuit and a block memory, Output a spatial filter characteristic control signal in sync with the above-mentioned reading control pulse signal to the above-mentioned spatial filter circuit, and the above-mentioned spatial filter circuit, An image processing device given in any 1 paragraph of claims 1-8 which reads image data of an address corresponding to a pixel signal output outputted from the above-mentioned transfer circuit from the above-mentioned block memory, and is characterized by performing a predetermined spatial filter process serially to the above-mentioned pixel signal to described image data.

A sensor circuit which has a transfer circuit which transmits a pixel signal which should read a described image processing means from a pixel array.

A control circuit.

A spatial filter circuit for performing a spatial filter process serially in the different predetermined characteristic.

A block memory which memorizes a signal of a predetermined sensor pixel group temporarily.

[Claim 10]A picture input device carrying an image processing device of a statement in any 1 paragraph of above-mentioned claims 1-9.

[Claim 11]An image processing method comprising:

An image input step.

An image-processing step which makes it correspond to several different spatial filter characteristics to the same image data in image data processed by a described image input step, and performs two or more spatial filter operations serially.

[Claim 12]Have a described image processing step and control management which controls the characteristic of a spatial filter circuit which can change selectivity about the predetermined geometric feature the above-mentioned control management, The image processing method according to claim 11 taking out serially two or more spatial filter outputs which give the spatial filter characteristic that two or more limited individuals set up beforehand differ, to inputted image data, and are related with the above-mentioned inputted image data. [Claim 13]While it has the following and the above-mentioned control management outputs a reading control pulse signal of the above-mentioned pixel signal to the above-mentioned sensor circuit, Based on the above-mentioned reading control pulse signal, output a spatial filter characteristic control signal to the above-mentioned spatial filter circuit, and the above-mentioned spatial filter process, The image processing device according to claim 11 or 12 characterized by performing a different predetermined spatial filter process serially to the above-mentioned pixel signal corresponding to a pixel signal output outputted from the above-mentioned transfer circuit.

Control management which controls operation of a sensor circuit which has a transfer circuit which transmits a pixel signal which should read a described image processing step from a pixel array.

A spatial filter process which controls a spatial filter circuit for performing a spatial filter process serially by the different predetermined characteristic.

[Claim 14]While it has the following and the above-mentioned control management outputs a reading control pulse signal of the above-mentioned pixel signal to the above-mentioned sensor circuit, Processing which outputs a spatial filter characteristic control signal to the above-mentioned spatial filter circuit based on the above-mentioned reading control pulse signal, and controls operation of the above-mentioned demultiplexer circuits, Based on the above-mentioned reading control pulse signal, the separation output of the time series signal from the above-mentioned sensor circuit is carried out at a different signal wire combined with the above-mentioned spatial filter circuit element. An image processing method given in any 1 paragraph of claims 11-13, wherein processing which controls operation of the above-mentioned spatial filter constituent circuits performs a different predetermined spatial filter process serially to the above-mentioned pixel signal corresponding to a pixel signal output outputted from the above-mentioned transfer circuit.

Control management which controls operation of a sensor circuit which has a transfer circuit which transmits a pixel signal which should read a described image processing step from a pixel array.

Processing which controls operation of demultiplexer circuits.

Processing which controls operation of a spatial filter array circuit which arranges spatial filter constituent circuits for performing a spatial filter process serially by the different predetermined characteristic.

[Claim 15]An image processing method given in any 1 paragraph of claims 11-14 which is provided with the following and characterized by the above-mentioned control management outputting a read pulse signal in sync with an output timing signal of the above-mentioned spatial filter circuit to the above-mentioned transfer circuit.

Control management by which a described image processing step controls operation of a transfer circuit which transmits a pixel signal of a sensor pixel.

Processing which controls operation of a spatial filter circuit which performs a spatial filter process serially by the different predetermined characteristic.

[Claim 16]The image processing method according to claim 15, wherein processing which controls operation of the above-mentioned spatial filter circuit performs serially predetermined local spatial filtering in two or more scales in scale space.

[Claim 17]The above-mentioned local spatial filtering processing is a predetermined multiplex scale spatial filter process which gives an output approximated to a Gabor filter or the above-mentioned Gabor filter output, The image processing method according to claim 16 performing serially filtering which has different scale selectivity and different directional selectivity.

[Claim 18]A storage recording a program for making a computer constitute each means of a statement on any 1 paragraph of above-mentioned claims 1-10 and in which computer reading is possible.

[Claim 19]A storage recording a program for making a computer perform a method of a statement on any 1 paragraph of above-mentioned claims 11-17 and in which computer reading is possible.

[Claim 20]A computer program recording a program for making a computer perform a method of a statement on any 1 paragraph of above-mentioned claims 11-17.

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention about an image processing device, a picture input device, an image processing method, a storage, and a computer program, It uses in order to perform sensor signal processing which processes the imaging signal from image sensors, such as a CMOS sensor, and performs image processing, such as recognition, detection, extraction, etc. of a photographic subject, especially, and it is related with a suitable circuit. [0002]

[Description of the Prior Art]By integrating an analog processing circuit to the image sensor as a solid state image pickup device conventionally, The composition (JP,2000-13694,A, JP,11-266002,A) etc. of the semiconductor chip which integrated a solid state image pickup device, and a spatial filter process and other functions as various image sensors which added the image processing function are known. [0003]On the other hand, As a trial which adds a living body's initial visual function to an image sensor. There is research (C. Mead, "Analog VLSI and Neural Systems", -AddisonWesley Pub., 1989, USP No. 4786818 gazette) of the silicon retina by Mead and others, and A pixel array, A pixel access control circuit, a multiplexer, and a dignity control circuit are integrated to a one chip, and there are artificial retina LSI (video

information media academic journal Vol.53, No.2, pp.178-183, 1999) etc. which realize a predetermined filtering function. [0004]Hereafter, operation of a CMOS sensor circuit is explained as conventional technology.Drawing 8 shows the rough circuitry figure (drive circuit figure of a CMOS sensor) of the sensor circuit concerning JP,11-196332,A. The sensor circuit performs the video signal outputs to the spatial filter circuit etc. of the imaging signal processing circuit mentioned above.

[0005]In drawing 8, the optoelectric transducer consists of photo-diode PD11 of a PN junction - PD22 --, and transmission MOS transistorST11 connected to the cathode - ST22 --. Carry out "H" output of the output V1 - V8 -- one by one by the vertical selection circuitry VSR, and activate vertical selection line HL1 and HL2 -- one by one, and. The one [ each horizontal transfer switch MOS transistorHT1 - HT8 -- ] by making the output H1 of the level selection circuitry HSR - H8 -- into "H" one by one, The image electric charge accumulated in each pixel is serially read from each vertical output line HV1 - HV8 -- to output line HOL one by one, and it is outputted via amplifier AMP.

[0006]And it resets output line HOL for every output of a pixel electric charge. [ reset MOS transistor RES ] Photo-diodes PD11-PD22 -- Inside vertical output line HV1 - vertical output line HV1 and photo-diode PD11 connected to HV2 of HV8 --, PD12, PD21, PD22, and PD31 -- are having the cathode side shaded as an object for extraction of a dark electric charge.

[0007]Drawing 9 shows the timing chart of infanticide read-out of a solid state camera. It flies and reads a read-out pixel at a time in one adjacent pixel in the level vertical row of the optoelectric transducer of the valid signal range.

[0008]First, make the output V1 into "H" by the vertical selection circuitry VSR, and let vertical selection line HL1 be "H". Then, the output H1 of the level selection circuitry HSR, H2, H3, H5, and H7 -- are made into "H" one by one, The image electric charge accumulated in each pixel is serially read from each vertical output line HV1, HV2, HV3, HV5, and HV7 -- to output line HOL one by one, and it outputs via amplifier AMP. [ horizontal transfer switch MOS transistorHT1, HT2, HT3, HT5, and HT7 -- ]

[0009]In that case, whenever and it read each pixel electric charge after making the output H1 of the level selection circuitry HSR, H2, H3, H5, and H7 -- into "H" one by

one, output line HOL was reset, and the influence of an adjacent pixel is lost. [ reset MOS transistor RES ]

[0010]Since the photoelectric conversion element group for a reference signal output of the photo-diodes PD11 and PD12 of a pixel is shaded, in drawing 9, the output OUT of amplifier AMP "H" signal, The low potential side level is outputted according to the electric charge of the 1st photoelectric conversion element group for a valid signal output of PD13, PD15, and PD17. Block read-out which reads the arbitrary range other than such infanticide read-out from the whole picture is performed similarly. [0011]The interval of infanticide can also be changed arbitrarily. As a conventional example which applied the spatial filter after read-out mentioned above, it is shown in JP,2000-13694,A etc. [0012]

[Problem(s) to be Solved by the Invention]However, in the above-mentioned conventional example, there was a problem which cannot carry out sequential sampling of the different geometric feature of the plurality defined beforehand efficiently in a single circuit to the image data inputted by the time series.

[0013]In order to extract the different geometric feature of the plurality beforehand defined by the array form circuit which the feature extraction circuit arranged in parallel spatially, it needed to input into the feature extraction circuit which separates the time series picture signal from a sensor spatially and where each corresponds. Matching with a sensor output and the address of the feature extraction circuit on an array form circuit needed to be performed. [0014]It sets it as the 1st purpose that this invention can be made to carry out sequential sampling of the different geometric feature of the plurality defined beforehand in a single circuit efficiently in view of an above-mentioned problem to the image data inputted by the time series. The spatial filter output modulated in time is interlocked with sensor output timing, and it sets it as the 2nd purpose that it is stabilized and is made to perform a spatial filter process which is different about the picturized picture efficiently.

[0015]

[Means for Solving the Problem]This invention is characterized by an image processing device comprising the following.

Image input means.

An image processing means which makes it correspond to several different spatial filter characteristics to the same image data inputted from a described image input means, and performs two or more spatial filter operations serially.

A pixel array which has a photoelectric transfer characteristic a place by which it is characterized [ of this invention / other ], A sensor area including a reading means for reading image data from the above-mentioned pixel array, It is characterized by forming in the same semiconductor chip an image processing means which makes it correspond to several different spatial filter characteristics to the same image data read from the above-mentioned sensor area, and performs two or more spatial filter operations serially. A place by which it is characterized [ of others of this invention ], A spatial filter circuit which the described image processing means can change [ of selectivity about the predetermined geometric feature ], Have an imaging signal processing circuit which consists of a control circuit which controls the characteristic of the above-mentioned spatial filter circuit, and the above-mentioned control circuit, It is characterized by taking out serially two or more spatial filter outputs which give the spatial filter characteristic that two or more limited individuals set up beforehand differ, to inputted image data, and are related with the above-mentioned inputted image data. A place by which it is characterized [ of others of this invention ], A sensor circuit which has a transfer circuit which transmits a pixel signal which should read a described image processing means from a pixel array, Have a control circuit and a spatial filter circuit for performing a spatial filter process serially in the different predetermined characteristic, and the above-mentioned control circuit, While outputting a reading control pulse signal of the above-mentioned pixel signal to the above-mentioned sensor circuit, Based on the above-mentioned reading control pulse signal, output a spatial filter characteristic control signal to the above-mentioned spatial filter circuit, and the above-mentioned spatial filter circuit, Corresponding to a pixel signal output outputted from the above-mentioned transfer circuit, it is characterized by performing a different predetermined spatial filter process serially to the above-mentioned pixel signal.A place by which it is characterized [ of others of this invention ], A sensor circuit which has a transfer circuit which transmits a pixel signal which should read a described image processing means from a pixel array, It has a control circuit, demultiplexer circuits, and a spatial filter array circuit that arranges spatial filter constituent circuits for performing a spatial filter process serially in the different predetermined characteristic, While the above-mentioned control circuit outputs a reading control pulse signal of the above-mentioned pixel signal to the

above-mentioned sensor circuit, Based on the above-mentioned reading control pulse signal, output a spatial filter characteristic control signal to the above-mentioned spatial filter circuit, and the above-mentioned demultiplexer circuits, Based on the above-mentioned reading control pulse signal, carry out a separation output at a different signal wire combined with the above-mentioned spatial filter circuit element, and a time series signal from the above-mentioned sensor circuit the above-mentioned spatial filter constituent circuits, Corresponding to a pixel signal output outputted from the above-mentioned transfer circuit, it is characterized by performing a different predetermined spatial filter process serially to the above-mentioned pixel signal. A place by which it is characterized [ of others of this invention ], A transfer circuit to which a described image processing means transmits a pixel signal of a sensor pixel, It has a control circuit and a spatial filter circuit which performs a spatial filter process serially in the different predetermined characteristic, and the above-mentioned control circuit is characterized by outputting a read pulse signal in sync with an output timing signal of the above-mentioned spatial filter circuit to the above-mentioned transfer circuit. A place by which it is characterized [ of others of this invention ] is characterized by the above-mentioned spatial filter circuit performing serially predetermined local spatial filtering in two or more scales in scale space. A place by which it is characterized [ of others of this invention ], It is characterized by the above-mentioned local spatial filtering performing serially filtering which has scale selectivity which is a predetermined multiplex scale spatial filter process which gives an output approximated to a Gabor filter or the above-mentioned Gabor filter output, and is different, and different directional selectivity. A place by which it is characterized [ of others of this invention ], A sensor circuit which has a transfer circuit which transmits a pixel signal which should read a described image processing means from a pixel array, A control circuit and a spatial filter circuit for performing a spatial filter process serially in the different predetermined characteristic, Have a block memory which memorizes a signal of a predetermined sensor pixel group temporarily, and the above-mentioned control circuit, While outputting a reading control pulse signal of the above-mentioned pixel signal to the above-mentioned sensor circuit and a block memory, Output a spatial filter characteristic control signal in sync with the above-mentioned reading control pulse signal to the above-mentioned spatial filter circuit, and the above-mentioned spatial filter circuit, Image data of an address corresponding to a pixel signal output outputted from the above-mentioned transfer circuit is read from the above-mentioned block memory, and it is characterized by performing a

predetermined spatial filter process serially to the above-mentioned pixel signal to described image data.

[0016]A picture input device of this invention is characterized by carrying an image processing device given in above any they are.

[0017]This invention is characterized by an image processing method comprising the following.

Image input step.

An image-processing step which makes it correspond to several different spatial filter characteristics to the same image data in image data processed by a described image input step, and performs two or more spatial filter operations serially.

A place by which it is characterized [ of this invention / other ] a described image processing step, Have the control management which controls the characteristic of a spatial filter circuit which can change selectivity about the predetermined geometric feature, and the above-mentioned control management, It is characterized by taking out serially two or more spatial filter outputs which give the spatial filter characteristic that two or more limited individuals set up beforehand differ, to inputted image data, and are related with the above-mentioned inputted image data. A place by which it is characterized [ of others of this invention ], Control management which controls operation of a sensor circuit which has a transfer circuit which transmits a pixel signal which should read a described image processing step from a pixel array, Have a spatial filter process which controls a spatial filter circuit for performing a spatial filter process serially by the different predetermined characteristic, and the above-mentioned control management, While outputting a reading control pulse signal of the above-mentioned pixel signal to the above-mentioned sensor circuit, Based on the above-mentioned reading control pulse signal, output a spatial filter characteristic control signal to the above-mentioned spatial filter circuit, and the above-mentioned spatial filter process, Corresponding to a pixel signal output outputted from the above-mentioned transfer circuit, it is characterized by performing a different predetermined spatial filter process serially to the above-mentioned pixel signal. A place by which it is characterized [ of others of this invention ], Control management which controls operation of a sensor circuit which has a transfer circuit which transmits a pixel signal which should read a described image processing step from a pixel array, It has the processing which controls operation of a spatial filter array

circuit which arranges spatial filter constituent circuits for performing a spatial filter process serially by processing which controls operation of demultiplexer circuits, and the different predetermined characteristic, While the above-mentioned control management outputs a reading control pulse signal of the above-mentioned pixel signal to the above-mentioned sensor circuit, Processing which outputs a spatial filter characteristic control signal to the above-mentioned spatial filter circuit based on the above-mentioned reading control pulse signal, and controls operation of the above-mentioned demultiplexer circuits, Based on the above-mentioned reading control pulse signal, the separation output of the time series signal from the above-mentioned sensor circuit is carried out at a different signal wire combined with the above-mentioned spatial filter circuit element, Processing which controls operation of the above-mentioned spatial filter constituent circuits is characterized by performing a different predetermined spatial filter process serially to the above-mentioned pixel signal corresponding to a pixel signal output outputted from the above-mentioned transfer circuit. A place by which it is characterized [ of others of this invention ], Control management by which a described image processing step controls operation of a transfer circuit which transmits a pixel signal of a sensor pixel, It has the processing which controls operation of a spatial filter circuit which performs a spatial filter process serially by the different predetermined characteristic, and the above-mentioned control management is characterized by outputting a read pulse signal in sync with an output timing signal of the above-mentioned spatial filter circuit to the above-mentioned transfer circuit. Processing whose place by which it is characterized [ of others of this invention ] controls operation of the above-mentioned spatial filter circuit is characterized by performing serially predetermined local spatial filtering in two or more scales in scale space. A place by which it is characterized [ of others of this invention ], The above-mentioned local spatial filtering processing is a predetermined multiplex scale spatial filter process which gives an output approximated to a Gabor filter or the above-mentioned Gabor filter output, It is characterized by performing serially filtering which has different scale selectivity and different directional selectivity.

[0018]A computer program of this invention is characterized by recording a program for making a computer perform a method given in above any they are.

[0019]

[Embodiment of the Invention](A 1st embodiment) Drawing 1 is a block diagram showing the entire configuration of the imaging signal processing circuit concerning this embodiment.

[0020]It is what performs the spatial filter operation of the characteristic that predetermined differs in the point corresponding to each picture element position on the sensor of the video signal into which the spatial filter circuit 1 is inputted from the sensor circuit 3 in drawing 1 to a time series. It has the function to extract different geometric image characteristic quantity about the field of the prescribed size centering on each point of a video signal.

[0021]While the control circuit 2 outputs the predetermined reading control pulse signal to the sensor circuit 3 according to predetermined timing so that it may mention later, It enables it to perform output from the sensor circuit 2, and processing of the spatial filter circuit 1 synchronously by outputting the timing pulse signal which synchronized with the reading control pulse signal also to the spatial filter circuit 1. Detailed control of the above-mentioned spatial filter circuit 1 is mentioned later.
[0022]Next, an example of read-out of a picture signal and its pretreatment are explained in detail using drawing 2. The photoelectric conversion device 10 which has arranged the optoelectric transducer to matrix form, Each horizontal line is activated one by one by vertical selection-circuitry VSR11, and the picture signal of the photoelectric conversion element group for a reference signal output and the photoelectric conversion element group for a valid signal output is outputted one by one via amplifier AMP by level selection-circuitry HSR12.

[0023]The output of the solid state camera constituted as mentioned above is inputted into the reference voltage generator 14 at the output period of the photoelectric conversion element group for a reference signal output, and generates reference voltage. In this case, when the photoelectric conversion element group for a reference signal output is 2 pixels, let that average value be reference voltage, for example.

[0024]Next, it is inputted into the clamp circuit 13 at the output period of the photoelectric conversion element group for a valid signal output, It is clamped by the reference voltage of the above-mentioned reference voltage generator 14, the reference voltage according to the dark electric charge of the same horizontal line of a photoelectric conversion device is deducted from the photoelectrical electrification

pressure of the photoelectric conversion element group for a valid signal output, and the picture signal according to a photoelectrical load is acquired.

[0025]In this case, the reference voltage of the reference voltage generator 14, After 1 horizontal line is read, it is reset, and anew, by the photoelectric conversion element group for a reference signal output of read-out of a horizontal line, reference voltage is generated, a difference is taken from the photoelectrical electrification pressure of the photoelectric conversion element group for a valid signal output, and a substantial picture signal is outputted. The output of the clamp circuit 13 is changed into a digital signal with A/D converter 15, and the spatial filter process explained below is made.

[0026]<The composition of a spatial filter circuit and operation> Drawing 3 is a figure simplifying and showing the example of composition of the spatial filter element used by this embodiment. Here, although even the output (hr (p**1, q**1), hi (p**1, q**1)) in the adjacent pixel position (p**1, q**1) by the side of these days [ of a picture element position (p, q) ] is displayed, this circuit element has arranged in two dimensions actually. [0027]In drawing 3, hr (p, q) and hi (p, q) express the real part and the imaginary part of a filter output (it explains below) corresponding to the picture element position (p, q) on a sensor, respectively.The input/output control of these spatial filter constituent circuits is explained later. [0028]The spatial filter used here is what is called a Gabor type filter that performs the output approximated to a Gabor filter or a Gabor filter output. There is spatial frequency selectivity about a determined direction, i.e., directional selectivity (have sensitivity for the edge direction ingredient of the prescribed range in a picture) and scale selectivity (have sensitivity with the size of the prescribed range in a picture or the geometric feature of spatial frequency).

[0029]According to this embodiment, multiplex scale processing in which the Gabor type filter was used performs Gabor wavelet conversion to an inputted image.About the method and circuit which perform Gabor wavelet conversion. Literature IEEE Trans. on Acoustics, Speech, and Signal Processing, vol.36, and pp.1169-1179 (1988), And IEEE Trans. on Circuits and Systems-I: Please refer to Fundamental Theory and Applications, vol.45, pp.121-132. (1998), etc.

[0030]The spatial filter used by this embodiment is what can control these selectivity by the characteristics (conductance, the gain of an amplifier, etc.) of a circuit element, In drawing 3, a certain point (p, q) in an inputted image. A center. The Gabor type

filtering operation about a local domain to carry out. The example of composition of the circuit element to perform. Literature 1(B.E.Shi, "2D Focal Plane Steerabale and Scalable Cortical Filters", Proc. of Seventh International Conference on It is shown Microelectronics for Neural, Fuzzy, and Bio-Inspired Systems, and based on pp.232-239. 1999.

[0031]In drawing 3, the element shown with the trapezoid is the transconductance type amplifier (as composition which makes a gain variable, indicated to JP,7-235839,A, JP,11-68477,A, etc.) which used five MOS transistors typically.

[0032]Each resistance element is constituted by the CMOS transmission gate. (For example) By two CMOS transistors etc. Composition;. Literature 2: B.E.Shi "SubthresholdCurrent Mode design of Gabor-type CNN Image Filters, Proc. European Conference on Circuit Theory The label G of and Design, pp.1163-1169, 1999, and a resistance element expresses conductance, and the label G of each transconductance type amplifier expresses a gain.As a filter circuit, each transistor may be operated above a threshold and may be operated below with a threshold.

[0033]Next, the input of the image data to a filter circuit is explained.A pixel signal is sent to memory device Cm of drawing 3 to predetermined timing from the sensor circuit driven with the reading control pulse signal outputted from the control circuit 2.
[0034]An address (picture element position) makes the input part of the spatial filter constituent circuits of (p, q), and this memory device and transconductance amplifier Gs exist for every (every filter element circuit) address.Read-out of a filter output is performed after all transmission of the picture signal to the input part (memory device Cm) of each filter element circuit ends.

[0035]A pixel signal is temporarily held as a voltage signal at memory device Cm combined with the transconductance amplifier Gs of an input part, If the output from a spatial filter circuit is read by the predetermined filter output read signal from a control circuit, operation which rewrites the contents of the memory device will be performed.The data held at the memory device is voltage with the transconductance amplifier Gs. - Current conversion is carried out and it is inputted as u (p, q).
[0036]The directional selectivity and scale selectivity of prescribed width centering on spatial frequency (wx0, wy0) are obtained with the spatial filter circuit element explained above.They are wx0= atan (G2x/G1x) and wy0= atan (G2y/G1y). The central direction theta of directional selectivity is given by theta= atan (wy0/wx0).

[0037]<Control outline of a spatial filter circuit> Next, the spatial filter element mentioned above explains the processing which extracts the geometric feature in the local domain centering on the predetermined sampling point of an inputted image by the filter array circuit arranged in two dimensions.The filter characteristics and the driving timing control signal of a spatial filter array circuit are collectively outputted to each filter element circuit (drawing 3) of a spatial filter array circuit from the control circuit of drawing 1.

[0038]That is, filter characteristics and a driving timing control signal control the filter characteristics of each filter element circuit collectively (updating). The sensor circuit mentioned above is thinned out in a prescribed interval about inputted image data, performs a read scanning, and outputs picture signal data. [0039]As a driving timing control signal which updates the characteristic of a spatial filter circuit, the control signal in sync with the output timing from the spatial filter circuit array of a stroke region is outputted from the control circuit 2.

[0040]If the reading control signal (sensor selection line signal of drawing 1) in sync with this control signal is outputted to vertical / horizontal selection circuitry of a sensor circuit, the picture signal data of an address corresponding from a sensor will be read.

[0041]The timing control signal (filter selection line signal of drawing 1) is outputted to the predetermined spatial filter constituent circuits in the filter array circuit corresponding to a sensor selection line signal (address in an inputted image) via a demultiplexer, The picture signal data of the address specified by the sensor selection line signal is transmitted to applicable spatial filter constituent circuits. [0042]Each spatial filter constituent circuits so that it may be set to one of the groups of the parameter value to which the directional selectivity which set up the spatial filter characteristic beforehand whenever there was an input of a filter selection line signal, and scale selectivity belong, After setting up G 0 each of drawing 3, G1x, G1y, G2x, and G2y (based on the filter-characteristics control signal from the control circuit 2), the image data from a sensor is inputted.

[0043]A scale parameter is made into omega-1=[wx02+wy02] -0.5, specifically using the above-mentioned spatial frequency selectivity parameter as each parameter value, The weighted solidity which each resistance and an amplifier should set up if each selectivity parameters omega and theta are given, alpha2=G2(max)

[1+cot2omega] as 0.5 and delta=lambda/(alphaomega), G1x=alpha2 cos (omegacostheta), G2x=alpha2 sin (omegacostheta), It is given like G1y=alpha2 cos (omegasintheta), G2y=alpha2 sin (omegasintheta), and G0=alpha2 [(deltaomega) 2+4-2cos(omegacostheta)-2cos (omegasintheta)] (literature 1). [0044]After transmission of the image data to all the spatial filter circuit elements about predetermined filter characteristics is completed, the spatial filter processing result which has the set-up characteristic is read. [0045]<A Gabor filter and Gabor wavelet conversion> Next, Gabor (type) filtering which each spatial filter performs is explained.It has the shape which modulated the sine wave which has a fixed direction component and spatial frequency with the Gaussian function (a Gabor type filter non-Gaussian function) so that a Gabor function may be given by a formula (1), The characteristic is set up by the index m of a scaling level and the index n of a direction component which are explained below.

[0046]The set of this filter function as a wavelet has the shape of a similar function form mutually, and a principal direction differs from a size mutually. The function form is carrying out localization of this wavelet in the spatial frequency domain and the real space domain, The simultaneous uncertainty about a position and spatial frequency serves as the minimum, It is the function which carried out localization most even in real space or frequency space. **********. (J.G.Daugman (1985), Uncertainty relation for resolution in space, spatial frequency, and orientation optimized by two-) dimensional visual cortical filters, Journal of Optical Society of America A, vol.2, pp. 1160-1169.

[0047]

[Equation 1]

[0048]The position in a picture and a express a scaling factor, in thetan, (x, y) express the direction component of a filter here, and fundamental space frequency and sigmaXsigmaY of W are parameters which give the size of the breadth of the x direction of a filter function, and a y direction. However, in the circuitry top shown in drawing 3, the shape of a Gaussian function form of (1) type was approximated by Laplacian.

[0049]In this embodiment, thetan as a direction-selective parameter takes a value of 0 times, 30 degrees, 60 degrees, 90 degrees, 120 degrees, and 150 degrees in six directions, and a sets it to 2, and it gives m as a scale selectivity parameter as an integer which takes values from 1 to 3. In a actual circuitry top, such selectivity is realized by controlling appropriately weighted solidity (a conductance value and a gain of a transconductance amplifier) of a circuit element of drawing 3. [0050]Since size (breadth) of a Gabor filter kernel (gmn of (1) type) changes according to the scale index m, a Gabor filter which has a different scale index has different size selectivity, but. Here, when it is assumed that there is breadth of a circuit array as shown in drawing 3 infinitely, the transfer function uses having spatial frequency selectivity (scale selectivity) (literature 1). [0051]A characteristics parameter of a filter chosen in the input time t of a driving timing control signal which carried out point ** is set with n (t) about m (t) and directional selectivity about scale selectivity. Two-dimensional convolution arithmetic operation of gm(t) n(t) (x, y) and an input shade image is performed about each filter which has this selected spatial filter characteristic (however, actually). in a circuit element as shown in drawing 3, a conversion output equivalent to convolution arithmetic operation of what made Laplacian the shape of a function form of gm(t) n(t) (x, y) is obtained -- a Gabor wavelet transformation is performed by things. namely[0052]

[Equation 2]

[0053]An inputted image and Wm(t) n(t) of I are Gabor wavelet transformation coefficients here. It asks on each point by making the set of Wm(t) n(t) (m (t) =1, 2, 3; n(t) =1, ..., 6) into a feature vector. "*" shows that a complex conjugate is taken.

[0054]As hi (p, q), the output (p, q), i.e., hr, of a spatial filter array of the circuit element shown in drawing 3, it is connected like Wm(t) n(t) ** hr(p, q)+j hi (p, q). [0055]Each spatial filter constituent circuits perform the wavelet transformation coefficient value output produced by performing the sum-of-products input of a distribution weighting factor and image data. Namely, the output from the spatial filter circuit element which gives predetermined filter characteristics about the data for the full screen from a sensor output is read to a time series, The result by which the filter output which gives a series of different filter characteristics similarly was made, It

means that Gabor wavelet conversion of (2) types was performed as a time series output (set of an equivalent [ to Wmn covering the whole range of the value which the indexes m and n of a formula (2) can take ] value) of the whole spatial filter array.

[0056]A time series output for every filter characteristics updated as follows is individually stored in two or more temporary storage means (or it is collectively single) as two-dimensional-array data once, respectively, and following processings (for example, processing image recognition etc.) are performed.For example, when a following treatment module which undergoes a spatial filter output is a neuron network which an arithmetic element which is plurality combines in parallel hierarchy, two-dimensional-array data mentioned above is usually (changed into a voltage signal) put in block, and is simultaneously outputted to a nerve element of an input layer.

[0057]<Transfer control of image data from a sensor circuit> With reference to drawing 1, it explains again hereafter.Whenever the control circuit 2 updates a characteristics parameter (m, n) of the Gabor type spatial filter array circuit 1, it outputs a control signal of each resistance and an amplifier gain in a spatial filter circuit element.

[0058]A gate voltage control signal of a transistor which specifically constitutes a CMOS transmission gate circuit where the control circuit 2 constitutes each resistance as a filter-characteristics control signal (VG1x, VG1y, VG0), And it outputs so that a gain control signal (VG2x, VG2y) to a transistor which constitutes a transconductance amplifier may be collectively updated by the characteristic of each spatial filter circuit element. [0059]Hereafter, composition of a control circuit, etc. are explained with reference to drawing 4.The control circuit 2 receives the internal memory measure 43 at a scale of a Gabor type filter, and a group (m, n) of a direction-selective index,Data of a group of a control signal value which gives a set (G0, G1x, G1y, G2x, G2y) of a respectively peculiar conductance value and an amplifier gain value is memorized as a table, If Vcon and (mn) are inputted from a direction and the scale selection signal generator 41 as a control signal corresponding to a group of each index, From the gate control signal generation circuit 42, control signal VG1x which gives a conductance value and an amplifier gain value which are shown below, VG1y, VG2x, VG2y, and VG0, It is outputted to a transistor which constitutes each resistance and an amplifier of each spatial filter circuit element which are shown in drawing 3.

[0060]Namely, G1x corresponding to Vcon and (mn) , (mn) , G2x, and (mn) , G1y, (mn) , G2y, and (mn) , G0, and (mn), Supposing it is given as follows, respectively, in a memory, control signal level VG1x corresponding to each, VG1y, VG2x, VG2y, and VG0 will be memorized corresponding to the above-mentioned index group (m, n). A value of G1x, (mn) , G2x, and (mn) , G1y, (mn) , G2y, and (mn) , G0, and (mn) with a definitional equation mentioned above. Using central direction thetan and center space frequency omegam, G1x, (mn) =alpham2 cos (omegamcosthetan), G2x, (mn) =alpham2 sin (omegamcosthetan), G1y, (mn) =alpham2 cos (omegamsinthetan), G2y, (mn) =alpham2 sin (omegamsinthetan), It is expressed like G0 and (mn) =alpham2 [(deltamomegam) 2+4-2cos(omegamcosthetan)-2cos (omegamsinthetan)].here -- alpham2=G2(max)[1+cot2omegam] 0.5 and deltam=lambda/(alphamomegam)

It comes out. [0061]Although a predetermined transistor of each circuit element of drawing 3 wires, a controlling signal line to each resistance and an amplifier is not illustrated in order to avoid complicatedness.

[0062]The control circuit 2 outputs a selection line signal of a line which should be made "H" one by one among each horizontal / vertical selection line to 3h of level selection circuitries and the vertical selection circuitry 3v in the sensor circuit 3 so that it may synchronize with output timing of a control signal from a direction and a scale selection signal generator mentioned above.

[0063]If the above-mentioned selection signal Vcon and (mn) which were updated are specifically outputted, Synchronizing with this, it is outputted to the sensor side by activation signal of a horizontal-selection-lines signal and a vertical selection line signal, and in a sensor circuit. If this activation signal is inputted, a selection line signal of a line which should be made "H" one by one will be outputted, and a pixel signal of a pixel which became active [ both horizontal selection lines and a vertical selection line ] is outputted to a spatial filter circuit mentioned above from a sensor. [0064]Thus, a pixel signal read as a time series signal is transmitted to an input part of each spatial filter circuit element (drawing 3) with the selected demultiplexer circuits 5 as follows.As the demultiplexer circuits 5, circuitry usually used may be suffioient (for example, it comprises a switch array, its activation circuit, etc.), and a pixel signal and a selection line signal which were pretreated are inputted, A pixel signal corresponding to a Gabor type spatial filter circuit element corresponding to a read-out picture element position in an inputted image decided by a selection line signal is outputted.

[0065]Next, read-out of an output from the Gabor type spatial filter array circuit 1 is explained.The scale parameter m and the direction component parameter n which should be set by a direction and a scale selection signal generator of the control circuit 2 are updated, and read-out is performed after all pixel signals that should be inputted into each filter circuit element are transmitted. [0066]For example, transmission finishing timing to a filter circuit element of image data read according to the above-mentioned parameter (m, n) of a Gabor type filter, Detect by inputting the last selection line signal, and a spatial filter output is read after that through a predetermined time delay decided by a device property, It is stored in a temporary storage means as two or more two-dimensional-array data (spatial filter array output for every identical property), or may output to a following treatment module as time series data as it is.

[0067]Since read-out of this spatial filter output is performed after a predetermined time delay from a filter selection line signal output which synchronized with a sensor selection line signal from the control circuit 2, it can take out a spatial filter output, holding a picture signal output from a sensor, and always fixed time correspondence. [0068]Matching of a spatial filter output mentioned above by suitable timing control of control of read-out of data from a sensor and the spatial filter characteristic while making circuit structure small, and a sensor output can be performed. [0069]When following treatment modules are parallel operation devices, such as a neuron network, Carry out the branch output of the read time series filter output to each element of an input stage by demultiplexer circuits etc., and to an input part of each element. A sample hold circuit or a temporary storage memory element holding a value of input data is introduced, or it may write in a predetermined block memory element as two-dimensional-array data, and a package output may be carried out after that at an input device array of a parallel operation device. [0070]As mentioned above, although address control and transfer control to a sensor circuit were performed in this embodiment based on control timing of a spatial filter circuit, It is good also as composition which performs same control based on intermediate treatment output timing etc. of other processing circuits other than a spatial filter mentioned above, for example, an image recognition circuit.

[0071]Next, composition of an imaging device (picture input device) which carries an imaging signal processing circuit which performs spatial filtering mentioned above is explained.By making a pattern recognition (detection) device using an imaging signal processing circuit concerning composition of this embodiment carry in a

photographing device explains a case where focusing to a specific photographic subject, color correction of a specific photographic subject, and exposure control are performed, with reference to drawing 5.

[0072]The imaging signal processing circuit 95 which performs spatial filter operation etc. which the imaging device 9 of drawing 5 requires for the image formation optical system 92, CMOS image sensor 93, the measurement means 94 of an imaging parameter, and this embodiment containing a taking lens and a drive controlling mechanism for zoom photography, the memory measure 96, control of imaging operation, The display display 98 which served as finders, such as the control signal generation means 97 which generates signals for control, such as control of image pick-up conditions, and EVF, the strobe light means 99, the recording medium 910, the object recognition means 911, etc. are provided. The object recognition means 911 has the function to perform detection of a pattern of a specific category, etc. out of a picture using a Gabor type wavelet transformation output from an imaging signal processing circuit. [0073]This imaging device detects a person's face picture beforehand registered out of an image photoed, for example by the object recognition means 911 (detection of an existence position and size). If the person's position and size information are inputted into a control signal generation means 97, the control signal generation means 97 will generate a control signal which performs focus control, exposure condition control, white balance control, etc. to the person the optimal based on an output from the imaging parameter measurement means 94.

[0074]A detection (recognition) function of the above-mentioned photographic subject is realizable for low power consumption and a high speed (real time) on a scale of a small circuit by using a pattern detection (recognition) device using an imaging signal processing circuit concerning this embodiment for an imaging device as mentioned above. Based on the result, a person's etc. detection and optimum control (AF, AE, etc.) of photography based on it were able to be performed.

[0075]This embodiment is applied when forming the sensor circuit 3, the control circuit 2 and the preprocessing circuit 4 which are shown in drawing 1, and the spatial filter circuit 1 in a case where it forms in a separate semiconductor chip, respectively, or the same semiconductor chip.

[0076]However, this embodiment demonstrates an effect more by forming each circuit shown in drawing 1 on the same semiconductor chip by a CMOS process etc.

[0077]According to this embodiment, to image data of a stroke region of a photoelectric conversion element array, two or more spatial filter circuits are provided, and two or more spatial filter operations which can be set in several different spatial filter characteristics are not performed in parallel, but one spatial filter is made to perform them serially.

[0078]If which of the sensor circuit 3 and the spatial filter 1 has a defect when the sensor circuit 3 and the spatial filter circuit 1 are formed in the same semiconductor chip, it will become impossible to use the chip and a yield will worsen. In this case, in providing two or more spatial filters, inconvenience to which a chip area becomes large and a yield worsens dramatically occurs. Like this embodiment mentioned above to it, when it is made to process in one spatial filter circuit serially, a chip area becomes small and a yield can be improved.

[0079]One spatial filter circuit which performs several different processings serially thus, by forming in the same semiconductor chip together with sensor circuit 3 grade, it becomes possible to obtain merits, such as a merit by preventing aggravation of a yield by forming two or more circuits on the same semiconductor chip, and forming in the same semiconductor chip, i.e., formation of few area, low-electric-power-izing, and low-pricing.

[0080](A 2nd embodiment) An important section configuration block figure of this embodiment is shown in drawing 6.Here, memory device Cm in an input part of a spatial filter circuit element of drawing 3 is unnecessary. A necessary part corresponding to a predetermined spatial filter circuit element serially accessed among sensor circuit outputs is once recorded on a block memory, It begins to read to a package after that by making each picture element data of a block memory into a voltage signal (it is a time series when using memory device Cm in a circuit of drawing 3), and a spatial filter process which was mentioned above is performed.

[0081]In this embodiment, the control circuit 2 like a 1st embodiment inside of a spatial filter characteristics parameter (m, n), With an address selection signal, send out a scale control signal corresponding to the scale parameter m to the sensor circuit side, and horizontal / vertical selection circuitry of a sensor circuit, The block memory 6 is made to memorize image data (local domain sampled by infanticide) of a local domain centering on each sampling pixel about predetermined region size according to this scale control signal.Load of the control circuit 2 which outputs a

read timing control signal to a sensor circuit can be made to reduce by doing in this way.

[0082]This block memory 6 achieves a function as a primary storage element, and according to a timing signal from the control circuit 2, Image data of a local field (size is scale parameter dependence) centering on each sampling position is sent out to each spatial filter circuit element corresponding to the sampling point position.
[0083]Image data which a block memory memorizes at this time, Whenever a sampling point position of infanticide is updated by a control signal from the control circuit 2, Picture signal data (after pretreatment) corresponding to the sampling point position is transmitted to a latter spatial filter array circuit, A picture signal from a sensor in the above-mentioned position (address) is inputted, and as a result of rewriting image data of a corresponding address on the block memory, it is updated as image data duplicate in a fixed range.

[0084]Then, it is serially outputted to a spatial filter circuit element as a picture signal by a control signal of the control circuit 2. Read-out and others of an output from a spatial filter circuit are the same as that of a 1st embodiment.

[0085]It is applied when forming the sensor circuit 3, the control circuit 2, the preprocessing circuit 4 and the block memory 6 which are shown in drawing 6 also in this case, and the spatial filter circuit 1 in a case where it forms in a separate semiconductor chip, respectively, or the same semiconductor chip.

[0086]However, this embodiment can demonstrate an effect more by forming each circuit shown in drawing 6 on the same semiconductor chip by a CMOS process etc.

[0087]According to this embodiment, to image data of a stroke region of a photoelectric conversion element array, two or more spatial filter circuits are provided, and two or more spatial filter operations which can be set in several different spatial filter characteristics are not performed in parallel, but one spatial filter is made to perform them serially.

[0088]If which of the sensor circuit 3 and the spatial filter 1 has a defect when the sensor circuit 3 and the spatial filter circuit 1 are formed in the same semiconductor chip, it will become impossible to use the chip and a yield will worsen. In this case, in providing two or more spatial filters, inconvenience to which a chip area becomes large and a yield worsens dramatically occurs. Like this embodiment mentioned above

to it, when it is made to process in one spatial filter circuit serially, a chip area becomes small and a yield can be improved.

[0089]The one spatial filter circuit 1 which performs several different processings serially thus, by forming in the same semiconductor chip together with sensor circuit 3 grade, It becomes possible to obtain merits, such as a merit by preventing aggravation of a yield by forming two or more circuits on the same semiconductor chip, and forming in the same semiconductor chip, i.e., formation of few area, low-electric-power-izing, and low-pricing.

[0090](A 3rd embodiment) Important section composition of this embodiment is shown in drawing 7.Here, the timing-control characteristic of a sensor circuit, i.e., modulation timing control by the side of a spatial filter circuit, is performed using a reading control signal used with the usual CMOS sensor.However, infanticide reading control as shown in a 1st embodiment shall be performed. [0091]If it does in this way, it is not necessary to add change to wiring of insides, such as read timing control about a CMOS sensor circuit, or a transfer circuit, and using the existing CMOS sensor chip etc., it is stabilized and spatial filtering operation can be performed.

[0092]The control circuit 2 inputs a selection line signal at the time of sensor read-out, acquires information on an address of a picture signal, and performs transfer control of a picture signal to a corresponding spatial filter circuit element of a position. [0093]Although a characteristic control signal of each circuit element (resistance, transconductance amplifier) which is made to correspond to a characteristics parameter (m, n) of a wavelet transformation of a Gabor type shown in a 1st embodiment at this time, and is shown in drawing 3 is sent out, The updating is performed after read operation from a sensor is completed briefly.For example, what is necessary is just to update, whenever infanticide read-out which should be performed about an inputted image is completed. A read scanning (infanticide) is again performed in a sensor circuit after the updating. [0094]A pixel signal will perform rewriting operation of the contents of the memory device, if it is temporarily held as a voltage signal at memory device Cm combined with the transconductance amplifier Gs of an input part like a 1st embodiment and an output from a spatial filter circuit is read.Other operations and composition are the same as that of a 1st embodiment. [0095]Also in this 3rd embodiment, when forming the sensor circuit 3, the control circuit 2 and the preprocessing circuit 4 which are shown in drawing 7, and the spatial

filter circuit 1 in a case where it forms in a separate semiconductor chip, respectively, or the same semiconductor chip, it is applied.

[0096]However, this embodiment can demonstrate an effect more by forming each circuit shown in drawing 7 on the same semiconductor chip by a CMOS process etc.

[0097]According to this embodiment, to image data of a stroke region of a photoelectric conversion element array, two or more spatial filter circuits are provided, and two or more spatial filter operations which can be set in several different spatial filter characteristics are not performed in parallel, but one spatial filter is made to perform them serially.

[0098]If which of the sensor circuit 3 and the spatial filter 1 has a defect when the sensor circuit 3 and the spatial filter circuit 1 are formed in the same semiconductor chip, it will become impossible to use the chip and a yield will worsen. In this case, in providing two or more spatial filters, inconvenience to which a chip area becomes large and a yield worsens dramatically occurs. Like this embodiment mentioned above to it, when it is made to process in the one spatial filter circuit 1 serially, a chip area becomes small and a yield can be improved.

[0099]The one spatial filter circuit 1 which performs several different processings serially thus, by forming in the same semiconductor chip together with sensor circuit 3 grade, It becomes possible to obtain merits, such as a merit by preventing aggravation of a yield by forming two or more circuits on the same semiconductor chip, and forming in the same semiconductor chip, i.e., formation of few area, low-electric-power-izing, and low-pricing.

[0100](Other embodiments of this invention) Even if it applies this invention to a system which comprises two or more apparatus, it may be applied to a device which consists of one apparatus.

[0101]So that a function of an embodiment mentioned above may be realized and various kinds of devices may be operated, As opposed to a computer in a device or a system connected with the various above-mentioned devices, A program code of software for realizing a function of the above-mentioned embodiment via transmission media, such as a storage to the Internet, is supplied, What was carried out by operating the various above-mentioned devices according to a program stored in a

computer (CPU or MPU) of the system or a device is contained under the category of this invention.

[0102]A function of an embodiment which the program code of the above-mentioned software itself mentioned above in this case will be realized, A storage which stored a means for supplying the program code itself and its program code to a computer, for example, this program code, constitutes this invention. As a storage which memorizes this program code, a floppy (registered trademark) disk, a hard disk, an optical disc, a magneto-optical disc, CD-ROM, magnetic tape, a nonvolatile memory card, ROM, etc. can be used, for example.

[0103]By executing a program code with which a computer was supplied, A function explained by an above-mentioned embodiment is not only realized, but, OS (operating system) or other application software etc. with which the program code is working in a computer work together. Also when a function shown by an above-mentioned embodiment is realized, it cannot be overemphasized that this program code is contained in an embodiment of the invention.

[0104]After a supplied program code was stored in a memory with which a function expansion unit connected to an expansion board of a computer or a computer is equipped, A part or all of processing that CPU etc. with which the expansion board and function expansion unit are equipped based on directions of the program code are actual is performed, and it is contained in this invention also when a function of an embodiment mentioned above by the processing is realized.

[0105]

[Effect of the Invention]Since according to this invention it is made to correspond to several different spatial filter characteristics to the same image data inputted from an image input means and was made to perform two or more spatial filter operations serially as this invention was mentioned above, Sequential sampling of the different geometric feature of the plurality defined beforehand can be efficiently carried out in a single circuit to the image data inputted by the time series. The spatial filter output modulated in time can be interlocked with sensor output timing, efficiently, it is stabilized and a spatial filter process which is different about the picturized picture can be performed.

[0106]The pixel array which has a photoelectric transfer characteristic according to the feature of others of this invention, A sensor area including the reading means for reading image data from the above-mentioned pixel array, Since the image processing means which makes it correspond to several different spatial filter characteristics to the same image data read from the above-mentioned sensor area, and performs two or more spatial filter operations serially was formed in the same semiconductor chip, Merits which are merits by preventing aggravation of the yield by forming two or more circuits on the same semiconductor chip, and forming in the same semiconductor chip, such as formation of few area, low-electric-power-izing, and low-pricing, can be obtained.

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[Translation done.]

* NOTICES *

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TECHNICAL FIELD

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[Field of the Invention]This invention about an image processing device, a picture input device, an image processing method, a storage, and a computer program, It uses in order to perform sensor signal processing which processes the imaging signal from image sensors, such as a CMOS sensor, and performs image processing, such as recognition, detection, extraction, etc. of a photographic subject, especially, and it is related with a suitable circuit.

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[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention]Since according to this invention it is made to correspond to several different spatial filter characteristics to the same image data inputted from an image input means and was made to perform two or more spatial filter operations serially as this invention was mentioned above, Sequential sampling of the different geometric feature of the plurality defined beforehand can be efficiently carried out in a single circuit to the image data inputted by the time series. The spatial filter output modulated in time can be interlocked with sensor output timing, efficiently, it is stabilized and a spatial filter process which is different about the picturized picture can be performed.

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[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]However, in the above-mentioned conventional example, there was a problem which cannot carry out sequential sampling of the different geometric feature of the plurality defined beforehand efficiently in a single circuit to the image data inputted by the time series.

[0013]In order to extract the different geometric feature of the plurality beforehand defined by the array form circuit which the feature extraction circuit arranged in parallel spatially, it needed to input into the feature extraction circuit which separates the time series picture signal from a sensor spatially and where each corresponds. Matching with a sensor output and the address of the feature extraction circuit on an array form circuit needed to be performed. [0014]It sets it as the 1st purpose that this invention can be made to carry out sequential sampling of the different geometric feature of the plurality defined beforehand in a single circuit efficiently in view of an above-mentioned problem to the image data inputted by the time series. The spatial filter output modulated in time is interlocked with sensor output timing, and it sets it as the 2nd purpose that it is stabilized and is made to perform a spatial filter process which is different about the picturized picture efficiently.

MEANS

[Means for Solving the Problem]This invention is characterized by an image processing device comprising the following.

Image input means.

An image processing means which makes it correspond to several different spatial filter characteristics to the same image data inputted from a described image input means, and performs two or more spatial filter operations serially.

A pixel array which has a photoelectric transfer characteristic a place by which it is characterized [ of this invention / other ], A sensor area including a reading means for reading image data from the above-mentioned pixel array, It is characterized by forming in the same semiconductor chip an image processing means which makes it correspond to several different spatial filter characteristics to the same image data

read from the above-mentioned sensor area, and performs two or more spatial filter operations serially. A place by which it is characterized [ of others of this invention ], A spatial filter circuit which the described image processing means can change [ of selectivity about the predetermined geometric feature ], Have an imaging signal processing circuit which consists of a control circuit which controls the characteristic of the above-mentioned spatial filter circuit, and the above-mentioned control circuit, It is characterized by taking out serially two or more spatial filter outputs which give the spatial filter characteristic that two or more limited individuals set up beforehand differ, to inputted image data, and are related with the above-mentioned inputted image data. A place by which it is characterized [ of others of this invention ], A sensor circuit which has a transfer circuit which transmits a pixel signal which should read a described image processing means from a pixel array, Have a control circuit and a spatial filter circuit for performing a spatial filter process serially in the different predetermined characteristic, and the above-mentioned control circuit, While outputting a reading control pulse signal of the above-mentioned pixel signal to the above-mentioned sensor circuit, Based on the above-mentioned reading control pulse signal, output a spatial filter characteristic control signal to the above-mentioned spatial filter circuit, and the above-mentioned spatial filter circuit, Corresponding to a pixel signal output outputted from the above-mentioned transfer circuit, it is characterized by performing a different predetermined spatial filter process serially to the above-mentioned pixel signal.A place by which it is characterized [ of others of this invention ], A sensor circuit which has a transfer circuit which transmits a pixel signal which should read a described image processing means from a pixel array, It has a control circuit, demultiplexer circuits, and a spatial filter array circuit that arranges spatial filter constituent circuits for performing a spatial filter process serially in the different predetermined characteristic, While the above-mentioned control circuit outputs a reading control pulse signal of the above-mentioned pixel signal to the above-mentioned sensor circuit, Based on the above-mentioned reading control pulse signal, output a spatial filter characteristic control signal to the above-mentioned spatial filter circuit, and the above-mentioned demultiplexer circuits, Based on the above-mentioned reading control pulse signal, carry out a separation output at a different signal wire combined with the above-mentioned spatial filter circuit element, and a time series signal from the above-mentioned sensor circuit the above-mentioned spatial filter constituent circuits, Corresponding to a pixel signal output outputted from the above-mentioned transfer circuit, it is characterized by performing a different predetermined spatial filter process serially to the

above-mentioned pixel signal. A place by which it is characterized [ of others of this invention ], A transfer circuit to which a described image processing means transmits a pixel signal of a sensor pixel, It has a control circuit and a spatial filter circuit which performs a spatial filter process serially in the different predetermined characteristic, and the above-mentioned control circuit is characterized by outputting a read pulse signal in sync with an output timing signal of the above-mentioned spatial filter circuit to the above-mentioned transfer circuit. A place by which it is characterized [ of others of this invention ] is characterized by the above-mentioned spatial filter circuit performing serially predetermined local spatial filtering in two or more scales in scale space. A place by which it is characterized [ of others of this invention ], It is characterized by the above-mentioned local spatial filtering performing serially filtering which has scale selectivity which is a predetermined multiplex scale spatial filter process which gives an output approximated to a Gabor filter or the above-mentioned Gabor filter output, and is different, and different directional selectivity. A place by which it is characterized [ of others of this invention ], A sensor circuit which has a transfer circuit which transmits a pixel signal which should read a described image processing means from a pixel array, A control circuit and a spatial filter circuit for performing a spatial filter process serially in the different predetermined characteristic, Have a block memory which memorizes a signal of a predetermined sensor pixel group temporarily, and the above-mentioned control circuit, While outputting a reading control pulse signal of the above-mentioned pixel signal to the above-mentioned sensor circuit and a block memory, Output a spatial filter characteristic control signal in sync with the above-mentioned reading control pulse signal to the above-mentioned spatial filter circuit, and the above-mentioned spatial filter circuit, Image data of an address corresponding to a pixel signal output outputted from the above-mentioned transfer circuit is read from the above-mentioned block memory, and it is characterized by performing a predetermined spatial filter process serially to the above-mentioned pixel signal to described image data.

[0016]A picture input device of this invention is characterized by carrying an image processing device given in above any they are.

[0017]This invention is characterized by an image processing method comprising the following.

Image input step.

An image-processing step which makes it correspond to several different spatial filter characteristics to the same image data in image data processed by a described image input step, and performs two or more spatial filter operations serially.

A place by which it is characterized [ of this invention / other ] a described image processing step, Have the control management which controls the characteristic of a spatial filter circuit which can change selectivity about the predetermined geometric feature, and the above-mentioned control management, It is characterized by taking out serially two or more spatial filter outputs which give the spatial filter characteristic that two or more limited individuals set up beforehand differ, to inputted image data, and are related with the above-mentioned inputted image data. A place by which it is characterized [ of others of this invention ], Control management which controls operation of a sensor circuit which has a transfer circuit which transmits a pixel signal which should read a described image processing step from a pixel array, Have a spatial filter process which controls a spatial filter circuit for performing a spatial filter process serially by the different predetermined characteristic, and the above-mentioned control management, While outputting a reading control pulse signal of the above-mentioned pixel signal to the above-mentioned sensor circuit, Based on the above-mentioned reading control pulse signal, output a spatial filter characteristic control signal to the above-mentioned spatial filter circuit, and the above-mentioned spatial filter process, Corresponding to a pixel signal output outputted from the above-mentioned transfer circuit, it is characterized by performing a different predetermined spatial filter process serially to the above-mentioned pixel signal. A place by which it is characterized [ of others of this invention ], Control management which controls operation of a sensor circuit which has a transfer circuit which transmits a pixel signal which should read a described image processing step from a pixel array, It has the processing which controls operation of a spatial filter array circuit which arranges spatial filter constituent circuits for performing a spatial filter process serially by processing which controls operation of demultiplexer circuits, and the different predetermined characteristic, While the above-mentioned control management outputs a reading control pulse signal of the above-mentioned pixel signal to the above-mentioned sensor circuit, Processing which outputs a spatial filter characteristic control signal to the above-mentioned spatial filter circuit based on the above-mentioned reading control pulse signal, and controls operation of the above-mentioned demultiplexer circuits, Based on the above-mentioned reading control pulse signal, the separation output of the time series signal from the

above-mentioned sensor circuit is carried out at a different signal wire combined with the above-mentioned spatial filter circuit element, Processing which controls operation of the above-mentioned spatial filter constituent circuits is characterized by performing a different predetermined spatial filter process serially to the above-mentioned pixel signal corresponding to a pixel signal output outputted from the above-mentioned transfer circuit. A place by which it is characterized [ of others of this invention ], Control management by which a described image processing step controls operation of a transfer circuit which transmits a pixel signal of a sensor pixel, It has the processing which controls operation of a spatial filter circuit which performs a spatial filter process serially by the different predetermined characteristic, and the above-mentioned control management is characterized by outputting a read pulse signal in sync with an output timing signal of the above-mentioned spatial filter circuit to the above-mentioned transfer circuit. Processing whose place by which it is characterized [ of others of this invention ] controls operation of the above-mentioned spatial filter circuit is characterized by performing serially predetermined local spatial filtering in two or more scales in scale space. A place by which it is characterized [ of others of this invention ], The above-mentioned local spatial filtering processing is a predetermined multiplex scale spatial filter process which gives an output approximated to a Gabor filter or the above-mentioned Gabor filter output, It is characterized by performing serially filtering which has different scale selectivity and different directional selectivity.

[0018]A computer program of this invention is characterized by recording a program for making a computer perform a method given in above any they are.

[0019]

[Embodiment of the Invention](A 1st embodiment) Drawing 1 is a block diagram showing the entire configuration of the imaging signal processing circuit concerning this embodiment.

[0020]It is what performs the spatial filter operation of the characteristic that predetermined differs in the point corresponding to each picture element position on the sensor of the video signal into which the spatial filter circuit 1 is inputted from the sensor circuit 3 in drawing 1 to a time series, It has the function to extract different geometric image characteristic quantity about the field of the prescribed size centering on each point of a video signal.

[0021]While the control circuit 2 outputs the predetermined reading control pulse signal to the sensor circuit 3 according to predetermined timing so that it may mention later, It enables it to perform output from the sensor circuit 2, and processing of the spatial filter circuit 1 synchronously by outputting the timing pulse signal which synchronized with the reading control pulse signal also to the spatial filter circuit 1. Detailed control of the above-mentioned spatial filter circuit 1 is mentioned later.
[0022]Next, an example of read-out of a picture signal and its pretreatment are explained in detail using drawing 2. The photoelectric conversion device 10 which has arranged the optoelectric transducer to matrix form, Each horizontal line is activated one by one by vertical selection-circuitry VSR11, and the picture signal of the photoelectric conversion element group for a reference signal output and the photoelectric conversion element group for a valid signal output is outputted one by one via amplifier AMP by level selection-circuitry HSR12.

[0023]The output of the solid state camera constituted as mentioned above is inputted into the reference voltage generator 14 at the output period of the photoelectric conversion element group for a reference signal output, and generates reference voltage. In this case, when the photoelectric conversion element group for a reference signal output is 2 pixels, let that average value be reference voltage, for example.

[0024]Next, it is inputted into the clamp circuit 13 at the output period of the photoelectric conversion element group for a valid signal output, It is clamped by the reference voltage of the above-mentioned reference voltage generator 14, the reference voltage according to the dark electric charge of the same horizontal line of a photoelectric conversion device is deducted from the photoelectrical electrification pressure of the photoelectric conversion element group for a valid signal output, and the picture signal according to a photoelectrical load is acquired.

[0025]In this case, the reference voltage of the reference voltage generator 14, After 1 horizontal line is read, it is reset, and anew, by the photoelectric conversion element group for a reference signal output of read-out of a horizontal line, reference voltage is generated, a difference is taken from the photoelectrical electrification pressure of the photoelectric conversion element group for a valid signal output, and a substantial picture signal is outputted. The output of the clamp circuit 13 is changed into a digital signal with A/D converter 15, and the spatial filter process explained below is made.

[0026]<The composition of a spatial filter circuit and operation> Drawing 3 is a figure simplifying and showing the example of composition of the spatial filter element used by this embodiment. Here, although even the output (hr (p**1, q**1), hi (p**1, q**1)) in the adjacent pixel position (p**1, q**1) by the side of these days [ of a picture element position (p, q) ] is displayed, this circuit element has arranged in two dimensions actually. [0027]In drawing 3, hr (p, q) and hi (p, q) express the real part and the imaginary part of a filter output (it explains below) corresponding to the picture element position (p, q) on a sensor, respectively.The input/output control of these spatial filter constituent circuits is explained later. [0028]The spatial filter used here is what is called a Gabor type filter that performs the output approximated to a Gabor filter or a Gabor filter output. There is spatial frequency selectivity about a determined direction, i.e., directional selectivity (have sensitivity for the edge direction ingredient of the prescribed range in a picture) and scale selectivity (have sensitivity with the size of the prescribed range in a picture or the geometric feature of spatial frequency).

[0029]According to this embodiment, multiplex scale processing in which the Gabor type filter was used performs Gabor wavelet conversion to an inputted image.About the method and circuit which perform Gabor wavelet conversion. Literature IEEE Trans. on Acoustics, Speech, and Signal Processing, vol.36, and pp.1169-1179 (1988), And IEEE Trans. on Circuits and Systems-I: Please refer to Fundamental Theory and Applications, vol.45, pp.121-132. (1998), etc.

[0030]The spatial filter used by this embodiment is what can control these selectivity by the characteristics (conductance, the gain of an amplifier, etc.) of a circuit element. In drawing 3, a certain point (p, q) in an inputted image. A center. The Gabor type filtering operation about a local domain to carry out. The example of composition of the circuit element to perform. Literature 1(B.E.Shi, "2D Focal Plane Steerabale and Scalable Cortical Filters", Proc. of Seventh International Conference on It is shown Microelectronics for Neural, Fuzzy, and Bio-Inspired Systems, and based on pp.232-239. 1999.

[0031]In drawing 3, the element shown with the trapezoid is the transconductance type amplifier (as composition which makes a gain variable, indicated to JP,7-235839,A, JP,11-68477,A, etc.) which used five MOS transistors typically.

[0032]Each resistance element is constituted by the CMOS transmission gate. (For example) By two CMOS transistors etc. Composition;. Literature 2; B.E.Shi "SubthresholdCurrent Mode design of Gabor—type CNN Image Filters, Proc. European Conference on Circuit Theory The label G of and Design, pp.1163—1169, 1999, and a resistance element expresses conductance, and the label G of each transconductance type amplifier expresses a gain.As a filter circuit, each transistor may be operated above a threshold and may be operated below with a threshold.

[0033]Next, the input of the image data to a filter circuit is explained.A pixel signal is sent to memory device Cm of drawing 3 to predetermined timing from the sensor circuit driven with the reading control pulse signal outputted from the control circuit 2.
[0034]An address (picture element position) makes the input part of the spatial filter constituent circuits of (p, q), and this memory device and transconductance amplifier Gs exist for every (every filter element circuit) address.Read—out of a filter output is performed after all transmission of the picture signal to the input part (memory device Cm) of each filter element circuit ends.

[0035]A pixel signal is temporarily held as a voltage signal at memory device Cm combined with the transconductance amplifier Gs of an input part, If the output from a spatial filter circuit is read by the predetermined filter output read signal from a control circuit, operation which rewrites the contents of the memory device will be performed.The data held at the memory device is voltage with the transconductance amplifier Gs. – Current conversion is carried out and it is inputted as u (p, q).
[0036]The directional selectivity and scale selectivity of prescribed width centering on spatial frequency (wx0, wy0) are obtained with the spatial filter circuit element explained above.They are wx0= atan (G2x/G1x) and wy0= atan (G2y/G1y). The central direction theta of directional selectivity is given by theta= atan (wy0/wx0).
[0037]<Control outline of a spatial filter circuit> Next, the spatial filter element mentioned above explains the processing which extracts the geometric feature in the local domain centering on the predetermined sampling point of an inputted image by the filter array circuit arranged in two dimensions.The filter characteristics and the driving timing control signal of a spatial filter array circuit are collectively outputted to each filter element circuit (drawing 3) of a spatial filter array circuit from the control circuit of drawing 1.

[0038]That is, filter characteristics and a driving timing control signal control the filter characteristics of each filter element circuit collectively (updating). The sensor circuit

mentioned above is thinned out in a prescribed interval about inputted image data, performs a read scanning, and outputs picture signal data. [0039]As a driving timing control signal which updates the characteristic of a spatial filter circuit, the control signal in sync with the output timing from the spatial filter circuit array of a stroke region is outputted from the control circuit 2.

[0040]If the reading control signal (sensor selection line signal of drawing 1) in sync with this control signal is outputted to vertical / horizontal selection circuitry of a sensor circuit, the picture signal data of an address corresponding from a sensor will be read.

[0041]The timing control signal (filter selection line signal of drawing 1) is outputted to the predetermined spatial filter constituent circuits in the filter array circuit corresponding to a sensor selection line signal (address in an inputted image) via a demultiplexer, The picture signal data of the address specified by the sensor selection line signal is transmitted to applicable spatial filter constituent circuits. [0042]Each spatial filter constituent circuits so that it may be set to one of the groups of the parameter value to which the directional selectivity which set up the spatial filter characteristic beforehand whenever there was an input of a filter selection line signal, and scale selectivity belong, After setting up G 0 each of drawing 3, G1x, G1y, G2x, and G2y (based on the filter-characteristics control signal from the control circuit 2), the image data from a sensor is inputted.

[0043]A scale parameter is made into omega-1=[wx02+wy02] -0.5, specifically using the above-mentioned spatial frequency selectivity parameter as each parameter value, The weighted solidity which each resistance and an amplifier should set up if each selectivity parameters omega and theta are given, alpha2=G2(max) [1+cot2omega] as 0.5 and delta=lambda/(alphaomega), G1x=alpha2 cos (omegacostheta), G2x=alpha2 sin (omegacostheta), It is given like G1y=alpha2 cos (omegasintheta), G2y=alpha2 sin (omegasintheta), and G0=alpha2 [(deltaomega) 2+4-2cos(omegacostheta)-2cos (omegasintheta)] (literature 1). [0044]After transmission of the image data to all the spatial filter circuit elements about predetermined filter characteristics is completed, the spatial filter processing result which has the set-up characteristic is read. [0045]<A Gabor filter and Gabor wavelet conversion> Next, Gabor (type) filtering which each spatial filter performs is explained.It has the shape which modulated the sine wave which has a fixed direction component and spatial frequency with the Gaussian function (a Gabor type filter

non-Gaussian function) so that a Gabor function may be given by a formula (1), The characteristic is set up by the index m of a scaling level and the index n of a direction component which are explained below.

[0046]The set of this filter function as a wavelet has the shape of a similar function form mutually, and a principal direction differs from a size mutually. The function form is carrying out localization of this wavelet in the spatial frequency domain and the real space domain, The simultaneous uncertainty about a position and spatial frequency serves as the minimum, It is the function which carried out localization most even in real space or frequency space. **********. (J.G.Daugman (1985), Uncertainty relation for resolution in space, spatial frequency, and orientation optimized by two-) dimensional visual cortical filters, Journal of Optical Society of America A, vol.2, pp. 1160-1169.

[0047]

[Equation 1]

[0048]The position in a picture and a express a scaling factor, in thetan, (x, y) express the direction component of a filter here, and fundamental space frequency and sigmaXsigmaY of W are parameters which give the size of the breadth of the x direction of a filter function, and a y direction. However, in the circuitry top shown in drawing 3, the shape of a Gaussian function form of (1) type was approximated by Laplacian.

[0049]In this embodiment, thetan as a direction-selective parameter takes a value of 0 times, 30 degrees, 60 degrees, 90 degrees, 120 degrees, and 150 degrees in six directions, and a sets it to 2, and it gives m as a scale selectivity parameter as an integer which takes values from 1 to 3. In a actual circuitry top, such selectivity is realized by controlling appropriately weighted solidity (a conductance value and a gain of a transconductance amplifier) of a circuit element of drawing 3. [0050]Since size (breadth) of a Gabor filter kernel (gmn of (1) type) changes according to the scale index m, a Gabor filter which has a different scale index has different size selectivity, but. Here, when it is assumed that there is breadth of a circuit array as shown in

drawing 3 infinitely, the transfer function uses having spatial frequency selectivity (scale selectivity) (literature 1). [0051]A characteristics parameter of a filter chosen in the input time t of a driving timing control signal which carried out point ** is set with n (t) about m (t) and directional selectivity about scale selectivity. Two-dimensional convolution arithmetic operation of gm(t) n(t) (x, y) and an input shade image is performed about each filter which has this selected spatial filter characteristic (however, actually). In a circuit element as shown in drawing 3, a conversion output equivalent to convolution arithmetic operation of what made Laplacian the shape of a function form of gm(t) n(t) (x, y) is obtained -- a Gabor wavelet transformation is performed by things. namely[0052]

[Equation 2]

[0053]An inputted image and Wm(t) n(t) of I are Gabor wavelet transformation coefficients here. It asks on each point by making the set of Wm(t) n(t) (m (t) =1, 2, 3; n(t) =1, ..., 6) into a feature vector. "*" shows that a complex conjugate is taken.

[0054]As hi (p, q), the output (p, q), i.e., hr, of a spatial filter array of the circuit element shown in drawing 3, it is connected like Wm(t) n(t) ** hr(p, q)+j hi (p, q). [0055]Each spatial filter constituent circuits perform the wavelet transformation coefficient value output produced by performing the sum-of-products input of a distribution weighting factor and image data. Namely, the output from the spatial filter circuit element which gives predetermined filter characteristics about the data for the full screen from a sensor output is read to a time series, The result by which the filter output which gives a series of different filter characteristics similarly was made, It means that Gabor wavelet conversion of (2) types was performed as a time series output (set of an equivalent [ to Wmn covering the whole range of the value which the indexes m and n of a formula (2) can take ] value) of the whole spatial filter array.

[0056]A time series output for every filter characteristics updated as follows is individually stored in two or more temporary storage means (or it is collectively single) as two-dimensional-array data once, respectively, and following processings (for example, processing image recognition etc.) are performed.For example, when a following treatment module which undergoes a spatial filter output is a neuron network

which an arithmetic element which is plurality combines in parallel hierarchy, two-dimensional-array data mentioned above is usually (changed into a voltage signal) put in block, and is simultaneously outputted to a nerve element of an input layer.

[0057]<Transfer control of image data from a sensor circuit> With reference to drawing 1, it explains again hereafter.Whenever the control circuit 2 updates a characteristics parameter (m, n) of the Gabor type spatial filter array circuit 1, it outputs a control signal of each resistance and an amplifier gain in a spatial filter circuit element.

[0058]A gate voltage control signal of a transistor which specifically constitutes a CMOS transmission gate circuit where the control circuit 2 constitutes each resistance as a filter-characteristics control signal (VG1x, VG1y, VG0), And it outputs so that a gain control signal (VG2x, VG2y) to a transistor which constitutes a transconductance amplifier may be collectively updated by the characteristic of each spatial filter circuit element. [0059]Hereafter, composition of a control circuit, etc. are explained with reference to drawing 4.The control circuit 2 receives the internal memory measure 43 at a scale of a Gabor type filter, and a group (m, n) of a direction-selective index,Data of a group of a control signal value which gives a set (G0, G1x, G1y, G2x, G2y) of a respectively peculiar conductance value and an amplifier gain value is memorized as a table, If Vcon and (mn) are inputted from a direction and the scale selection signal generator 41 as a control signal corresponding to a group of each index, From the gate control signal generation circuit 42, control signal VG1x which gives a conductance value and an amplifier gain value which are shown below, VG1y, VG2x, VG2y, and VG0, It is outputted to a transistor which constitutes each resistance and an amplifier of each spatial filter circuit element which are shown in drawing 3.

[0060]Namely, G1x corresponding to Vcon and (mn) , (mn) , G2x, and (mn) , G1y, (mn) , G2y, and (mn) , G0, and (mn), Supposing it is given as follows, respectively, in a memory, control signal level VG1x corresponding to each, VG1y, VG2x, VG2y, and VG0 will be memorized corresponding to the above-mentioned index group (m, n). A value of G1x, (mn) , G2x, and (mn) , G1y, (mn) , G2y, and (mn) , G0, and (mn) with a definitional equation mentioned above. Using central direction thetan and center space frequency omegam, G1x, (mn) =alpham2 cos (omegamcosthetan), G2x, (mn) =alpham2 sin (omegamcosthetan), G1y, (mn) =alpham2 cos (omegamsinthetan), G2y, (mn) =alpham2 sin (omegamsinthetan), It is expressed like G0 and (mn) =alpham2

[(deltamomegam) 2+4-2cos(omegamcosthetan)-2cos (omegamsinthetan)].here -- alpham2=G2(max)[1+cot2omegam] 0.5 and deltam=lambda/(alphamomegam)

It comes out. [0061]Although a predetermined transistor of each circuit element of drawing 3 wires, a controlling signal line to each resistance and an amplifier is not illustrated in order to avoid complicatedness.

[0062]The control circuit 2 outputs a selection line signal of a line which should be made "H" one by one among each horizontal / vertical selection line to 3h of level selection circuitries and the vertical selection circuitry 3v in the sensor circuit 3 so that it may synchronize with output timing of a control signal from a direction and a scale selection signal generator mentioned above.

[0063]If the above-mentioned selection signal Vcon and (mn) which were updated are specifically outputted, Synchronizing with this, it is outputted to the sensor side by activation signal of a horizontal-selection-lines signal and a vertical selection line signal, and in a sensor circuit. If this activation signal is inputted, a selection line signal of a line which should be made "H" one by one will be outputted, and a pixel signal of a pixel which became active [ both horizontal selection lines and a vertical selection line ] is outputted to a spatial filter circuit mentioned above from a sensor. [0064]Thus, a pixel signal read as a time series signal is transmitted to an input part of each spatial filter circuit element (drawing 3) with the selected demultiplexer circuits 5 as follows.As the demultiplexer circuits 5, circuitry usually used may be sufficient (for example, it comprises a switch array, its activation circuit, etc.), and a pixel signal and a selection line signal which were pretreated are inputted, A pixel signal corresponding to a Gabor type spatial filter circuit element corresponding to a read-out picture element position in an inputted image decided by a selection line signal is outputted.

[0065]Next, read-out of an output from the Gabor type spatial filter array circuit 1 is explained.The scale parameter m and the direction component parameter n which should be set by a direction and a scale selection signal generator of the control circuit 2 are updated, and read-out is performed after all pixel signals that should be inputted into each filter circuit element are transmitted. [0066]For example, transmission finishing timing to a filter circuit element of image data read according to the above-mentioned parameter (m, n) of a Gabor type filter, Detect by inputting the last selection line signal, and a spatial filter output is read after that through a predetermined time delay decided by a device property. It is stored in a temporary

storage means as two or more two-dimensional-array data (spatial filter array output for every identical property), or may output to a following treatment module as time series data as it is.

[0067]Since read-out of this spatial filter output is performed after a predetermined time delay from a filter selection line signal output which synchronized with a sensor selection line signal from the control circuit 2, it can take out a spatial filter output, holding a picture signal output from a sensor, and always fixed time correspondence. [0068]Matching of a spatial filter output mentioned above by suitable timing control of control of read-out of data from a sensor and the spatial filter characteristic while making circuit structure small, and a sensor output can be performed. [0069]When following treatment modules are parallel operation devices, such as a neuron network, Carry out the branch output of the read time series filter output to each element of an input stage by demultiplexer circuits etc., and to an input part of each element. A sample hold circuit or a temporary storage memory element holding a value of input data is introduced, or it may write in a predetermined block memory element as two-dimensional-array data, and a package output may be carried out after that at an input device array of a parallel operation device. [0070]As mentioned above, although address control and transfer control to a sensor circuit were performed in this embodiment based on control timing of a spatial filter circuit, It is good also as composition which performs same control based on intermediate treatment output timing etc. of other processing circuits other than a spatial filter mentioned above, for example, an image recognition circuit.

[0071]Next, composition of an imaging device (picture input device) which carries an imaging signal processing circuit which performs spatial filtering mentioned above is explained.By making a pattern recognition (detection) device using an imaging signal processing circuit concerning composition of this embodiment carry in a photographing device explains a case where focusing to a specific photographic subject, color correction of a specific photographic subject, and exposure control are performed, with reference to drawing 5.

[0072]The imaging signal processing circuit 95 which performs spatial filter operation etc. which the imaging device 9 of drawing 5 requires for the image formation optical system 92, CMOS image sensor 93, the measurement means 94 of an imaging parameter, and this embodiment containing a taking lens and a drive controlling mechanism for zoom photography, the memory measure 96, control of imaging

operation, The display display 98 which served as finders, such as the control signal generation means 97 which generates signals for control, such as control of image pick-up conditions, and EVF, the strobe light means 99, the recording medium 910, the object recognition means 911, etc. are provided. The object recognition means 911 has the function to perform detection of a pattern of a specific category, etc. out of a picture using a Gabor type wavelet transformation output from an imaging signal processing circuit. [0073]This imaging device detects a person's face picture beforehand registered out of an image photoed, for example by the object recognition means 911 (detection of an existence position and size). If the person's position and size information are inputted into a control signal generation means 97, the control signal generation means 97 will generate a control signal which performs focus control, exposure condition control, white balance control, etc. to the person the optimal based on an output from the imaging parameter measurement means 94.

[0074]A detection (recognition) function of the above-mentioned photographic subject is realizable for low power consumption and a high speed (real time) on a scale of a small circuit by using a pattern detection (recognition) device using an imaging signal processing circuit concerning this embodiment for an imaging device as mentioned above. Based on the result, a person's etc. detection and optimum control (AF, AE, etc.) of photography based on it were able to be performed.

[0075]This embodiment is applied when forming the sensor circuit 3, the control circuit 2 and the preprocessing circuit 4 which are shown in drawing 1, and the spatial filter circuit 1 in a case where it forms in a separate semiconductor chip, respectively, or the same semiconductor chip.

[0076]However, this embodiment demonstrates an effect more by forming each circuit shown in drawing 1 on the same semiconductor chip by a CMOS process etc.

[0077]According to this embodiment, to image data of a stroke region of a photoelectric conversion element array, two or more spatial filter circuits are provided, and two or more spatial filter operations which can be set in several different spatial filter characteristics are not performed in parallel, but one spatial filter is made to perform them serially.

[0078]If which of the sensor circuit 3 and the spatial filter 1 has a defect when the sensor circuit 3 and the spatial filter circuit 1 are formed in the same semiconductor chip, it will become impossible to use the chip and a yield will worsen. In this case, in

providing two or more spatial filters, inconvenience to which a chip area becomes large and a yield worsens dramatically occurs. Like this embodiment mentioned above to it, when it is made to process in one spatial filter circuit serially, a chip area becomes small and a yield can be improved.

[0079]One spatial filter circuit which performs several different processings serially thus, by forming in the same semiconductor chip together with sensor circuit 3 grade, It becomes possible to obtain merits, such as a merit by preventing aggravation of a yield by forming two or more circuits on the same semiconductor chip, and forming in the same semiconductor chip, i.e., formation of few area, low-electric-power-izing, and low-pricing.

[0080](A 2nd embodiment) An important section configuration block figure of this embodiment is shown in drawing 6.Here, memory device Cm in an input part of a spatial filter circuit element of drawing 3 is unnecessary. A necessary part corresponding to a predetermined spatial filter circuit element serially accessed among sensor circuit outputs is once recorded on a block memory, It begins to read to a package after that by making each picture element data of a block memory into a voltage signal (it is a time series when using memory device Cm in a circuit of drawing 3), and a spatial filter process which was mentioned above is performed.

[0081]In this embodiment, the control circuit 2 like a 1st embodiment Inside of a spatial filter characteristics parameter (m, n), With an address selection signal, send out a scale control signal corresponding to the scale parameter m to the sensor circuit side, and horizontal / vertical selection circuitry of a sensor circuit, The block memory 6 is made to memorize image data (local domain sampled by infanticide) of a local domain centering on each sampling pixel about predetermined region size according to this scale control signal.Load of the control circuit 2 which outputs a read timing control signal to a sensor circuit can be made to reduce by doing in this way.

[0082]This block memory 6 achieves a function as a primary storage element, and according to a timing signal from the control circuit 2, Image data of a local field (size is scale parameter dependence) centering on each sampling position is sent out to each spatial filter circuit element corresponding to the sampling point position.
[0083]Image data which a block memory memorizes at this time, Whenever a sampling point position of infanticide is updated by a control signal from the control circuit 2,

Picture signal data (after pretreatment) corresponding to the sampling point position is transmitted to a latter spatial filter array circuit, A picture signal from a sensor in the above-mentioned position (address) is inputted, and as a result of rewriting image data of a corresponding address on the block memory, it is updated as image data duplicate in a fixed range.

[0084]Then, it is serially outputted to a spatial filter circuit element as a picture signal by a control signal of the control circuit 2. Read-out and others of an output from a spatial filter circuit are the same as that of a 1st embodiment.

[0085]It is applied when forming the sensor circuit 3, the control circuit 2, the preprocessing circuit 4 and the block memory 6 which are shown in drawing 6 also in this case, and the spatial filter circuit 1 in a case where it forms in a separate semiconductor chip, respectively, or the same semiconductor chip.

[0086]However, this embodiment can demonstrate an effect more by forming each circuit shown in drawing 6 on the same semiconductor chip by a CMOS process etc.

[0087]According to this embodiment, to image data of a stroke region of a photoelectric conversion element array, two or more spatial filter circuits are provided, and two or more spatial filter operations which can be set in several different spatial filter characteristics are not performed in parallel, but one spatial filter is made to perform them serially.

[0088]If which of the sensor circuit 3 and the spatial filter 1 has a defect when the sensor circuit 3 and the spatial filter circuit 1 are formed in the same semiconductor chip, it will become impossible to use the chip and a yield will worsen. In this case, in providing two or more spatial filters, inconvenience to which a chip area becomes large and a yield worsens dramatically occurs. Like this embodiment mentioned above to it, when it is made to process in one spatial filter circuit serially, a chip area becomes small and a yield can be improved.

[0089]The one spatial filter circuit 1 which performs several different processings serially thus, by forming in the same semiconductor chip together with sensor circuit 3 grade, it becomes possible to obtain merits, such as a merit by preventing aggravation of a yield by forming two or more circuits on the same semiconductor chip, and forming in the same semiconductor chip, i.e., formation of few area, low-electric-power-izing, and low-pricing.

[0090](A 3rd embodiment) Important section composition of this embodiment is shown in drawing 7.Here, the timing-control characteristic of a sensor circuit, i.e., modulation timing control by the side of a spatial filter circuit, is performed using a reading control signal used with the usual CMOS sensor.However, infanticide reading control as shown in a 1st embodiment shall be performed. [0091]If it does in this way, it is not necessary to add change to wiring of insides, such as read timing control about a CMOS sensor circuit, or a transfer circuit, and using the existing CMOS sensor chip etc., it is stabilized and spatial filtering operation can be performed.

[0092]The control circuit 2 inputs a selection line signal at the time of sensor read-out, acquires information on an address of a picture signal, and performs transfer control of a picture signal to a corresponding spatial filter circuit element of a position. [0093]Although a characteristic control signal of each circuit element (resistance, transconductance amplifier) which is made to correspond to a characteristics parameter (m, n) of a wavelet transformation of a Gabor type shown in a 1st embodiment at this time, and is shown in drawing 3 is sent out, The updating is performed after read operation from a sensor is completed briefly.For example, what is necessary is just to update, whenever infanticide read-out which should be performed about an inputted image is completed. A read scanning (infanticide) is again performed in a sensor circuit after the updating. [0094]A pixel signal will perform rewriting operation of the contents of the memory device, if it is temporarily held as a voltage signal at memory device Cm combined with the transconductance amplifier Gs of an input part like a 1st embodiment and an output from a spatial filter circuit is read.Other operations and composition are the same as that of a 1st embodiment. [0095]Also in this 3rd embodiment, when forming the sensor circuit 3, the control circuit 2 and the preprocessing circuit 4 which are shown in drawing 7, and the spatial filter circuit 1 in a case where it forms in a separate semiconductor chip, respectively, or the same semiconductor chip, it is applied.

[0096]However, this embodiment can demonstrate an effect more by forming each circuit shown in drawing 7 on the same semiconductor chip by a CMOS process etc.

[0097]According to this embodiment, to image data of a stroke region of a photoelectric conversion element array, two or more spatial filter circuits are provided, and two or more spatial filter operations which can be set in several different spatial filter characteristics are not performed in parallel, but one spatial filter is made to perform them serially.

[0098]If which of the sensor circuit 3 and the spatial filter 1 has a defect when the sensor circuit 3 and the spatial filter circuit 1 are formed in the same semiconductor chip, it will become impossible to use the chip and a yield will worsen. In this case, in providing two or more spatial filters, inconvenience to which a chip area becomes large and a yield worsens dramatically occurs. Like this embodiment mentioned above to it, when it is made to process in the one spatial filter circuit 1 serially, a chip area becomes small and a yield can be improved.

[0099]The one spatial filter circuit 1 which performs several different processings serially thus, by forming in the same semiconductor chip together with sensor circuit 3 grade, it becomes possible to obtain merits, such as a merit by preventing aggravation of a yield by forming two or more circuits on the same semiconductor chip, and forming in the same semiconductor chip, i.e., formation of few area, low-electric-power-izing, and low-pricing.

[0100](Other embodiments of this invention) Even if it applies this invention to a system which comprises two or more apparatus, it may be applied to a device which consists of one apparatus.

[0101]So that a function of an embodiment mentioned above may be realized and various kinds of devices may be operated, As opposed to a computer in a device or a system connected with the various above-mentioned devices, A program code of software for realizing a function of the above-mentioned embodiment via transmission media, such as a storage to the Internet, is supplied, What was carried out by operating the various above-mentioned devices according to a program stored in a computer (CPU or MPU) of the system or a device is contained under the category of this invention.

[0102]A function of an embodiment which the program code of the above-mentioned software itself mentioned above in this case will be realized, A storage which stored a means for supplying the program code itself and its program code to a computer, for example, this program code, constitutes this invention. As a storage which memorizes this program code, a floppy (registered trademark) disk, a hard disk, an optical disc, a magneto-optical disc, CD-ROM, magnetic tape, a nonvolatile memory card, ROM, etc. can be used, for example.

[0103]By executing a program code with which a computer was supplied, A function explained by an above-mentioned embodiment is not only realized, but, OS (operating

system) or other application software etc. with which the program code is working in a computer work together. Also when a function shown by an above-mentioned embodiment is realized, it cannot be overemphasized that this program code is contained in an embodiment of the invention.

[0104]After a supplied program code was stored in a memory with which a function expansion unit connected to an expansion board of a computer or a computer is equipped, A part or all of processing that CPU etc. with which the expansion board and function expansion unit are equipped based on directions of the program code are actual is performed, and it is contained in this invention also when a function of an embodiment mentioned above by the processing is realized.

## DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]It is a block diagram showing the important section composition of the imaging signal processing circuit concerning a 1st embodiment.

[Drawing 2]It is a figure showing the example of composition of a sensor circuit and a preprocessing circuit.

[Drawing 3]It is a figure showing the example of composition of a spatial filter circuit element.

[Drawing 4]It is a figure showing the example of a block configuration of the control circuit used by this invention.

[Drawing 5]It is a figure showing the example of composition of the imaging device which performs object recognition which carries the imaging signal processing circuit of this invention.

[Drawing 6]It is a figure showing the important section composition of the imaging signal processing circuit concerning a 2nd embodiment.

[Drawing 7]It is a figure showing the important section composition of the imaging signal processing circuit concerning a 3rd embodiment.

[Drawing 8]It is a figure showing the example of important section composition of a sensor circuit.

[Drawing 9]It is a figure showing the timing control at the time of infantioide read-out by a sensor circuit.

[Description of Notations]

1 Spatial filter circuit

2 Control circuit

3 Sensor circuit

3h horizontal shift register

3 t Transfer circuit

3v Vertical shift register

4 Preprocessing circuit

5 Demultiplexer circuits

6 Block memory

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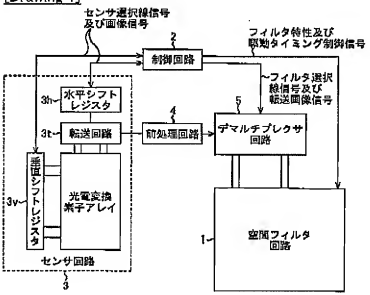
[Translation done.]

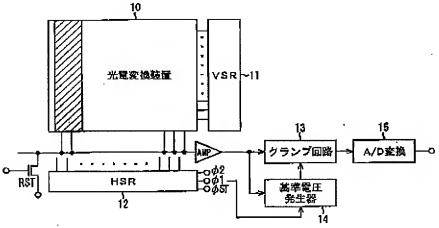
* NOTICES *

## DRAWINGS

[Drawing 1]




[Drawing 2]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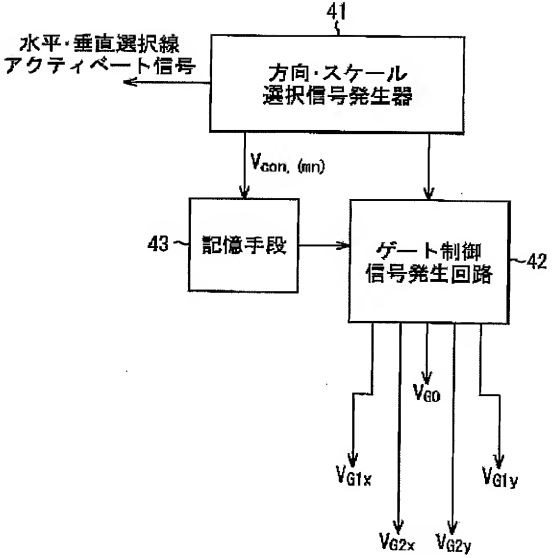
光電変換装置
VSR
11
13
15
AMP
クランプ回路
A/D変換
RST
HSR
12
φ2
φ1
φST
基準電圧
発生器
14

[Drawing 4]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アクティベート信号
方向・スケール
選択信号発生器
$V_{con.\ (mn)}$
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記憶手段
ゲート制御
信号発生回路
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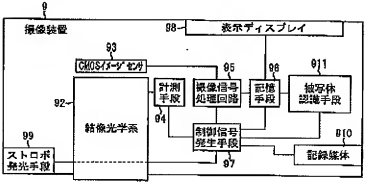
$V_{G1x}$
$V_{G1y}$
$V_{G2x}$
$V_{G2y}$

[Drawing 5]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撮像装置
98
表示ディスプレイ
93
CMOSイメージセンサ
95
96
911
計測手段
撮像信号処理回路
記憶手段
被写体認識手段
92
結像光学系
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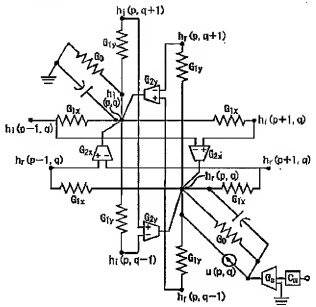
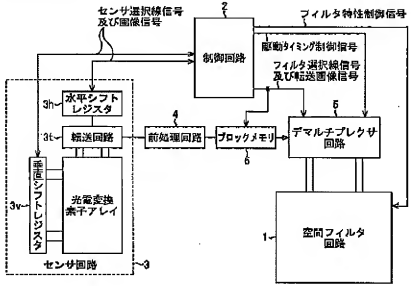
制御信号発生手段
910
99
ストロボ発光手段
97
記録媒体

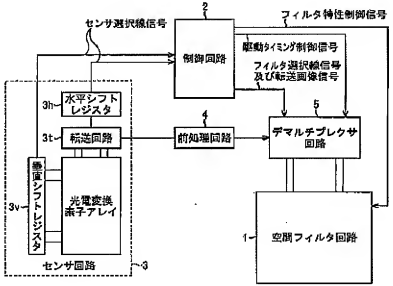
[Drawing 3]



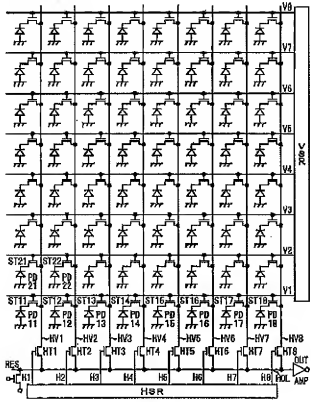

[Drawing 6]



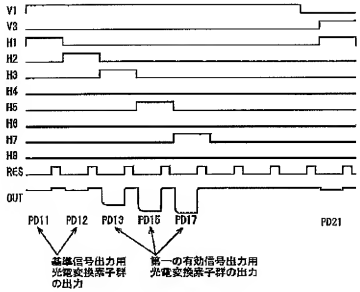

[Drawing 7]




[Drawing 8]




[Drawing 9]

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[Translation done.]